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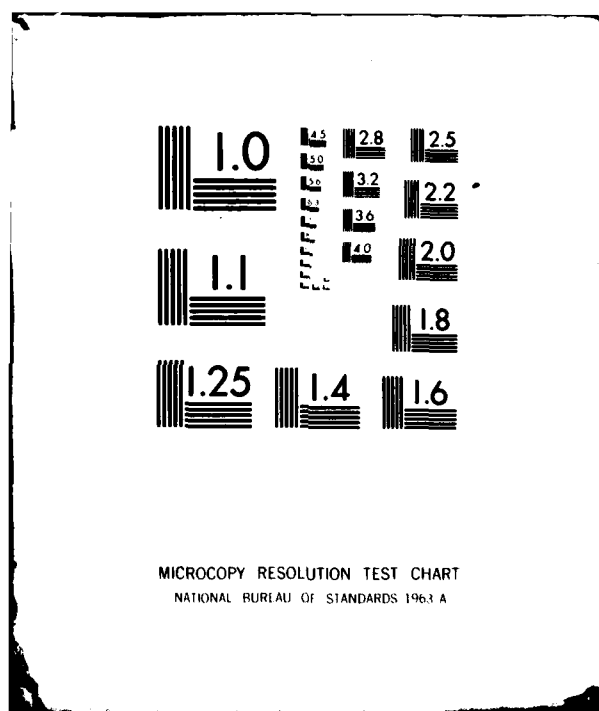
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A STUDY OF THE MANPOWER PLANNING AND ALLOCATION PROCESS OF THE UNITED STATES AIR FORCE LOGISTICS COMMAND

A Thesis

Presented in Partial Fulfillment of the Requirements
for the Degree Master of Science

by

Kendall Carl Rogers, B.S.I.E.

The Ohio State University
1979

Approved by

Adviser

Department of Industrial
and Systems Engineering

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THESIS ABSTRACT

THE OHIO STATE UNIVERSITY
GRADUATE SCHOOL

NAME Kendall Carl Rogers   DEGREE M.S.

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TITLE OF THESIS A Study of the Manpower Planning and

Allocation Process of the United States Air Force Logistics

Command

The planning for and allocation of human resources in the
private and public sector is an important function of all
entities within these sectors. This study presents a
detailed look at the process employed by the Air Force
Logistics Command in allocating manpower resources when new
work loads are undertaken. New work loads are normally
generated as a result of weapon system acquisition and the
impact of the acquisition is examined through a case study
of the A-10 weapon system. A new approach for allocating
manpower that is related directly to weapon system opera-
tion is proposed.

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Chapter I

INTRODUCTION

In the management of modern day business activities, both in the private and public sector, one of the most important resources that must be properly utilized is manpower. A distinct difference can be noted between the two sectors. In the private sector, management (within certain limits) has the capacity to hire the manpower resources necessary to produce goods or provide services as deemed necessary to conduct a successful business enterprise. On the other hand, government agencies (whether at the local, state, or national level) can only hire those manpower resources for which an approved budget, paid for by the taxpayer, can bear. In the public sector, the production of goods is generally nonexistent but the providing of services to the taxpayer is the main business for which it is engaged. This paper is an attempt to analyze the manpower resources used by one segment of the public sector with emphasis placed on the allocation of limited manpower resources to a vast network of support services.

Nature of the Study

For study of a public entity at any level, the
selection should be one which is complex enough to be of
interest, but simple enough to be understood and analyzed.
For instance, city government could be chosen since the
average city provides services in the areas of police and
fire protection, garbage collection, water service, park
and recreation, etc. At the state level, in transporta-
tion alone, services for highway maintenance, automobile
registration, drivers' licenses issuance, and assorted
other services are demanded by the public. While the
hiring and allocation of human resources for these
activities should be dictated by crime rates, state of
repair of roads and highways, budget constraints may
prevail.

At the national level, the problem is even more com-
plex. Budgeting for social programs versus defense expen-
ditures is debated endlessly. However, nearly all
citizens are concerned that adequate national defense be
provided at the lowest cost possible. The government
agency charged with the responsibility of providing this
defense is the Department of Defense. Within the
Department of Defense, the Air Force, Army, and Navy are
charged with providing the necessary manpower to carry out
the defense effort. With the conclusion of the Viet Nam

war, these agencies have seen a decline in manpower resources both as a result of manpower available and Congressional limitations placed on the agencies as to the number of personnel that can be employed at a given time. As a result of the continual purchases of defense hardware such as aircraft, tanks, and ships, one of the most important aspects of national defense is the support requirements that are necessary to maintain the hardware in operational ready status in the event it becomes necessary to deploy the forces in time of war. It is this aspect of utilization of human resources that appears to be most affected when manpower resources are funded by Congress. This is due to the fact that the systems' operators are considered the most important when manpower allocations are levied. It does not make sense to buy an aircraft and not allocate personnel to pilot the vehicle; it apparently makes sense not to support it.

For instance, the Air Force Logistics Command is charged by the Department of the Air Force with providing the necessary support to the operating commands in the areas of depot maintenance, supplies, war reserve materials, equipment repairs, and a host of other services necessary to keep the Air Force aircraft that are in the inventory at peak operating capability. The assigned

manpower strength of this command as of 30 September 1978 was 91,605. The total United States Air Force manpower assigned as of this date was 796,808. This means that a mere 11% of the total Air Force population is allocated to the support role. It should be noted, however, that this support does not include the active duty personnel assigned to the operating units at base level.

Within this support arena, the cost of manpower represents perhaps more than 50% (York, 1975) of the cost of maintaining the weapon systems over their life. Thus, it becomes necessary to efficiently utilize the allocated manpower in an effort to maintain the support required at the lowest possible cost.

As in the selection process for any type of study, one consideration that influences the area of concentration is the availability of data. As stated above, another criterion for selecting a public entity for study involves the complexity of the services provided. For this study, the manpower allocation process for the Air Force Logistics Command has been chosen as the entity to be analyzed. This choice was made based on the two factors stated: first, data were accessible and readily available; and secondly, the nature of services is sufficiently complex.

The Importance of the Problem

New weapon systems are constantly being acquired in
an effort to provide updated and modern weapon systems,
and to provide for an advanced state of defense. Since
new systems are usually state-of-the-art and in most cases
are somewhat more complex than their predecessors, the
support requirements increase steadily. Concurrent with
this increase in support requirements, we are faced with
a decrease in manpower resources. Consequently, the
efficient and effective allocation of these resources
becomes extremely important. This is complicated by the
fact that the new systems are costing more while the
Congressional emphasis is in cutting defense cost. Thus,
manpower resources will continually decrease since over
50% of the support cost is in the area of manpower.
Decline can be offset only if an effective manpower allo-
cation system is used.

It might be concluded that, since new updated systems
are continually entering the inventory, older systems
are being eliminated. This is partly true. A replaced
system normally is assigned to the Air Force Reserves or
National Guard units. The Air Force Logistics Command,
however, is still responsible for providing support for
these systems. However, there are systems that are removed

completely from the inventory. These are normally systems that have been operated by the Reserve and Guard units. This means that when a new system enters the inventory, the support for that system will require a certain level of manpower but the overall Air Force Logistics Command increased requirements will be less than the new system requirements since some manpower will be shifted from the outgoing system to the new system.

In addition to direct or primary manpower allocations, the planning for total manpower during the acquisition process must include support manpower.

Objectives of the Study

As stated in the previous section, effective allocation of manpower is paramount since that resource is on the decline. This study will focus on the current manpower allocation process as employed by the Air Force Logistics Command and will provide a descriptive model of this process. The process of weapon system acquisition will be discussed in relation to manpower requirements during the acquisition cycle. The primary vehicle for the analysis is a case study.

As an integral part of the study, an alternative allocation system will be proposed; and, the implications of adoption of this system will be discussed.

Methodology

A review of Department of Defense and Air Force regulations with regards to Systems Acquisition and Logistics Support Planning and a literature review on the topic of manpower planning were undertaken. A study of the current Air Force Logistics Command manpower planning and allocation process was conducted through interviews of manpower personnel (Chapter 2).

Detailed analysis of the A-10 weapon systems acquisition and its effect on manpower were undertaken. This analysis included interviews with personnel assigned to the A-10 System Program Office, the Air Force Acquisition Logistics Division, and the Sacramento Air Logistics Center. A detailed analysis of the manpower allocation for the A-10 logistics support is provided (Chapter 3).

A new manpower allocation model was developed and compared to the existing model used by manpower planners (Chapter 4).

A summary of this study and conclusions reached are provided in Chapter 5. Some personal thoughts on the Role of the Industrial Engineer in the Manpower Planning and Allocation Process are provided in the Appendix.

Chapter II

MANPOWER PLANNING AND ALLOCATION CONCEPTS

<u>The Private Sector</u>

In discussing manpower planning and allocation con-
cepts, it has become necessary to depart (in most instances)
from the study of a public sector entity and consider the
private sector at the outset. Although the discussion will
consider the private sector, much of the material can be
related to the public sector entity of interest.

What is manpower planning? "Broadly stated, manpower
planning is usually thought of as comprising those
activities that are integral to building an estimate of
the size and characteristics of the future work force of
an organization" (Wikstrom, 1963). A second definition,
provided by Vetter (1964), is: "the process by which a
firm insures that it has the right number of people and
the right kind of people, at the right places, at the
right time doing things for which they are economically
most useful." The implication of these meanings will
become clearer later in this study.

Armstrong (1977) has stated that one of the aims of
manpower planning is to insure that organizations make

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the best use of its manpower resources and the organization
is able to anticipate the problems arising from potential
surpluses or deficits of manpower. Further, an increase
in activity level can be catered to by improving the
productivity of the current work force in lieu of recruit-
ing more staff. This viewpoint is consistent with
Congressional planners in the public sector with regard
to wasted manpower; their claim being that a certain
level of work can be maintained with less personnel if
they were producing to capacity.

The general concept, however, can be summed up as:
when new work is received, hire the necessary personnel,
train the hirees and place on the job (Northcott, 1956).
This viewpoint is consistent with other authors who have
written on manpower planning and policies (Meyers, 1977;
Weber, et al, 1969; Ginsburg, 1958; Gordon, 1967).

The interesting aspect of the manpower planning role
in business is that it appears there is a lack of concern
for reallocation of manpower resources. As described
above, the planning function concentrates on estimating
needs and acquiring manpower to meet those needs. It
would be reasonable, however, to expect some attention
to be paid to the possible reallocation of manpower
resources when new work is received. With the exception

of Armstrong's comment concerning increased productivity
with the current work force as a means of accepting new
work without additional hiring, reallocation of existing
resources does not appear to be a problem in the private
sector. This conclusion, while harsh, is based on an
extensive review of several periodicals, Personnel (1962-
1975), the Personnel Journal (1964-1979), Personnel
Administration (1962-1979), and Operations Research (1974-
1979). The review failed to disclose any articles or
studies dealing with manpower reallocations.

Thus, it is reasonable to state that manpower planning
in the private sector is dedicated to the hiring, training,
and placement of personnel into the jobs for which they
were hired. The connotation implies that the allocation
of manpower to specific jobs is a function of the person-
nel recruitment process. An alternative to this course of
action occurs in the public sector.

The Public Sector

In the references cited above, manpower planning
and policies concentrate on the private sector. In
searching for published information concerning manpower
planning and allocation processes within the Department
of Defense, a search of the Defense Logistics Studies

Information Exchange was conducted. This search revealed that through early 1979, 395 studies relating to manpower have been reported.

A review of these studies failed to disclose any information concerning manpower allocations. What was found was that studies have been conducted that provide for methods to determine manpower requirements at the base unit. For instance, "A new method for determining the maintenance manpower requirements of new aircraft..." (Tetmeyer, 1974). What is lacking is information concerning manpower planning for logistics support. This is not to say, however, that no mechanism exists for the planning of logistics support personnel or that an allocation process does not exist. What is implied is that no real problems in this area have been recognized. However, it is known that the Air Force Logistics Command resorts to "crisis management" when new weapon systems are procured and the logistics support of these systems is transferred to the command. That crisis management involves the immediate reallocation of manpower resources from an existing work load to the new work load. Or, as an alternative to the reallocation process, the manpower planner simply ignores the new work load and assumes that the manpower resources associated with the acquisition of

the system are sufficient to support the system when it is transferred to the command for management. The assignment of personnel by the Air Force Logistics Command during the acquisition process will be explained later.

The Current Planning Concept

To understand fully the current manpower planning concept and allocation process, it is necessary to describe the United States Air Force weapon system acquisition process since it is this action that generates the new work load for which existing manpower must be allocated.

Each major system acquisition program has its unique features; no two are identical. Differences in time, cost, technology, management, and contracting approach must be recognized. However, despite the differences, the basic acquisition process is common to all programs. All weapon system acquisitions begin with a mission need statement issued by the United States Air Force, based on a mission analysis.

The mission need statement includes the mission purpose, capability, agency components involved, the command responsible for the mission (such as the Strategic Air Command in the case of a long-range retaliatory mission),

time constraints, value or worth of meeting the need,
relative priority, and operating constraints. It does
not address equipment or other means which might satisfy
the need. The mission need statement is submitted to
Congress for approval. If approved by Congress, the
weapon system acquisition cycle begins. For discussion
purposes, it will be assumed that a determination has
been made that an aircraft should be required to satisfy
the mission need. Therefore, the responsibility for the
start of the acquisition cycle is assigned to the Air Force
Systems Command, which initiates the system acquisition
cycle through the Aeronautical Systems Division.

The system acquisition process is a sequence of
specified phases of program activity and decision events
directed to the achievement of established program objec-
tives. The first phase of this process is known as the
conceptual phase.

During this phase, a concept to provide the required
capability is formed, its feasibility is studied, and
tested. The military, technical, and economic bases
are established by the combined effort of the concerned
operational command (the eventual operator of the new
system), Air Force Systems Command (the acquisition agency),

and Headquarters United States Air Force (the responsible agency who submitted the need statement).

The preliminary design, maintenance, and operational concepts formulated during this phase become the basis for the initial logistics support estimates and alternatives. These alternatives address the impact of any new design, operational concepts, materials, or components on the current or anticipated logistics support capabilities. The estimates include gross cost estimates for logistics support. The issue of logistics support is addressed later.

The second phase of the system acquisition cycle is the validation phase. This phase consists of those steps necessary to verify preliminary design and engineering, and to solicit and evaluate proposals for engineering development from defense contractors. Program characteristics (performance, cost, and schedule) are validated and refined through extensive study and analysis, hardware development, or prototype testing. The bread board and advanced prototyping efforts are to confirm that the technology is feasible and that the design concept has military utility. Test hardware developed during this phase should demonstrate adequate risk reduction.

The overall objective of the phase is to resolve unknowns and verify that the technical and economic basis for initiating the third phase of the acquisition process, full scale development, exist.

In the full scale development phase, the weapon system, including its support equipment, is engineered, fabricated, and tested. Near-production prototypes are built to verify final design or producibility. System engineering is conducted to support design verification, reviews, test and deployment, identification of detailed requirements for personnel, training, equipment quantity determinations, maintenance, and spares allocations. The intended output of this phase, as a minimum, is a pre-production system that closely approximates the final product.

The fourth phase of the process is the production phase. The system, as well as the training equipment, spares, facilities, and so forth, are produced for operational use. The primary objective of this phase is to produce and deliver to the operating command, an effective, supportable system, efficiently and at the lowest cost. During this phase, operational test and evaluation of the final product are tested by the ultimate user. The

transfer of management responsibility for the system from the Air Force Systems Command to the Air Force Logistics Command occurs during this phase.

The fifth phase of the acquisition cycle is the deployment phase. This phase overlaps the production phase and is affected when the weapon system is turned over to the using command. During this phase, operational units are trained, equipment is distributed, and necessary logistical support is provided.

The span of time that is encompassed during the acquisition cycle varies from system to system. Each system progresses on its own time table. Some cycles can be as short as three years for nonmajor systems to 15 or more years for a major system. As an example, the acquisition cycle for the F-111 aircraft began with the conceptual phase in 1957 and the system remained in production until 1976. The life cycle of a weapon system after production typically extends another 15 to 30 years. Therefore, logistics support for the new system begins during the early acquisition process and extends for many years. Coordination of the development of logistics support requirements with the acquisition process is accomplished through the Integrated Logistics Support function.

I

Integrated Logistics Support is a composite of all the support considerations necessary to assure the effective and economical support of a system for its life cycle. Logistics Support is an integral part of every aspect of the system acquisition process and system operations. Integrated Logistics Support is characterized by harmony and coherence among all the logistics elements. The principal elements of support are:

    a. Maintainability and reliability.

    b. The maintenance plan.

    c. Support and test equipment.

    d. Supply support.

    e. Transportation and handling.

    f. Technical data.

    g. Facilities.

    h. Personnel and training.

    i. Logistics support resource funds.

    j. Logistics support management information.

The output of the Integrated Logistics Support function is recommended support parameters for the above elements. Such parameters are provided as qualitative and quantitative maintainability and reliability inputs to the design process for use in design trade offs, risk analysis, and development of a logistics support capability

responsive to the operational requirements of the weapon
system.

The Integrated Logistics Support function is imple-
mented through the Integrated Logistics Support Plan. This
document provides a comprehensive and detailed plan for
implementing the concepts, techniques and policies neces-
sary to achieve the support objective of assuring the
effective economical support of a system for its life cycle.
The plan describes the Air Force management objectives,
structure, and activities for integration of the logistics
elements into program planning, development, test and
evaluation, production, and operational processes. The
responsibility for developing the plan rests with the
program manager.

The program manager is one person, selected by the
acquisition agency, who is totally responsible for the
system throughout the acquisition process until such time
as the management responsibility is transferred to the
support agency. To carry out this responsibility, the
program manager maintains a System Program Office with
eight main divisions (see Figure 1). While all the divi-
sions play an integral part in the development of the plan,
the Integrated Logistics Support Division is the primary

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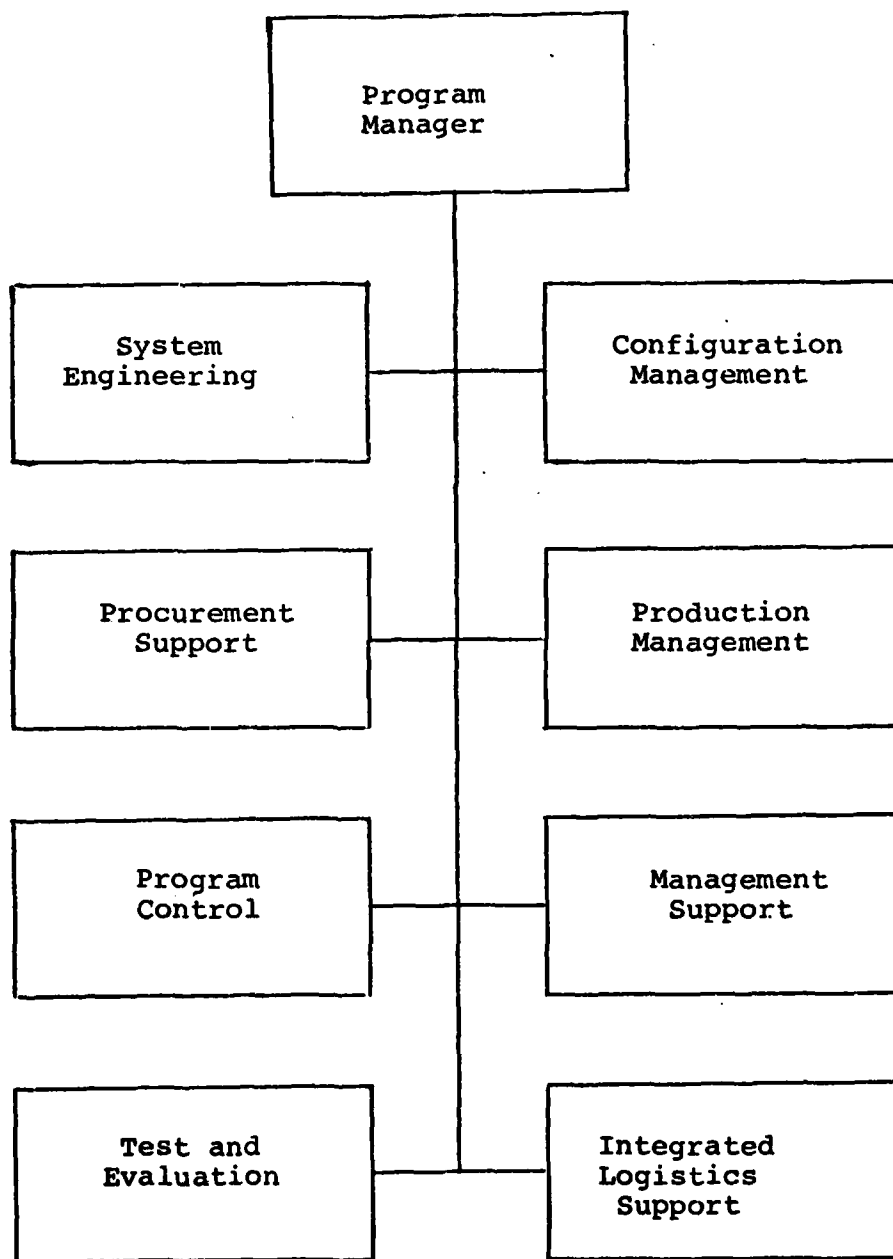
Figure 1

office of responsibility.   This office is directed by the
Deputy Program Manager for Logistics.

The Air Force Acquisition Logistics Division, an
element of the Air Force Logistics Command, has command
responsibility for logistics planning and implementation
during the conceptual, validation, and full scale develop-
ment phases of the acquisition cycle.   The Air Force
Acquisition Logistics Division exercises this responsi-
bility through the logistics manager assigned to the
System Program Office.   The system management Air Logistics
Center is normally designed concurrently with the estab-
lishment of the System Program Office to provide a single
logistics center management focal point to plan, inte-
grate, track, and control all internal center activities
relating to the program.

The Air Logistics Center assignment is a very impor-
tant element in the planning process.   It is the Air
Logistics Center which is assigned during the acquisition
process that will inherit the new work load required to
support the acquired system.   Also, the crisis management
situation referred to earlier occurs at this organizational
level, normally within the Directorate of Material
Management.   Figure 2 depicts this structure.   There are
five such Air Logistics Centers within the Air Force

AIR LOGISTICS CENTER STRUCTURE

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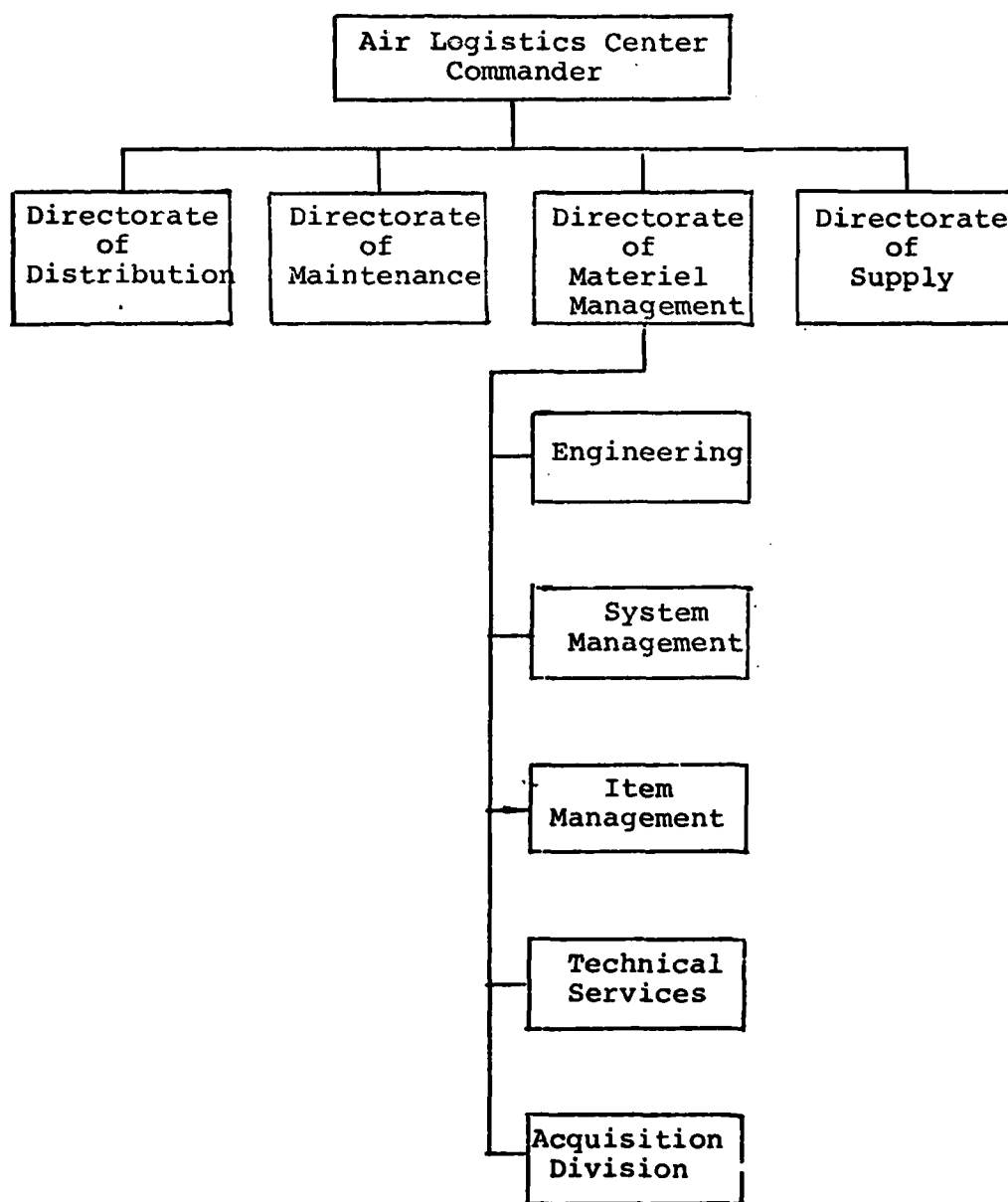
Figure 2

Logistics Command structure. These centers, in addition to providing system management and logistics support, have the responsibility for depot maintenance, which include all repairs and overhauls of subsystems. The process by which the centers receive the additional work load is known as the "program management responsibility transfer." It will be addressed later.

Within the System Program Office, the logistics manager is responsible for planning, coordinating, and directing the integrated logistics support and logistics management activities as directed by the program manager. The logistics manager accomplishes this task by obtaining functional area support from the appropriate organizations as necessary. A diagram of this process is shown in Figure 3.

The time table for developing the Integrated Logistics Support function, in relation to the acquisition cycle, requires that a general plan for logistics support be available during the conceptual phase. Although this is a macro plan, it is expected that special logistical problems will be noted in the validation phase. Early in the full scale development phase, the plan should include appropriate milestones. The plan should be fully implemented by the start of the production effort. By the time

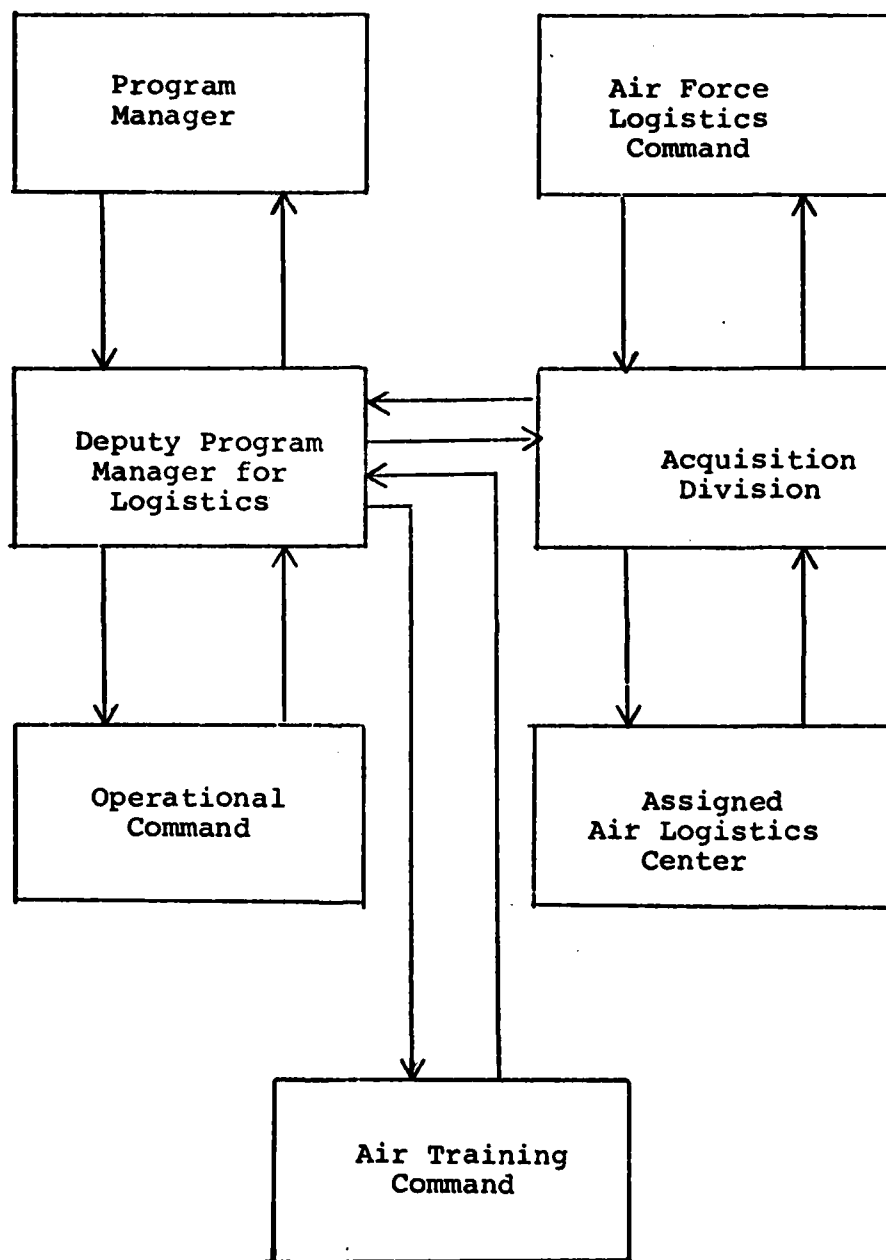INFORMATION FLOWS IN

INTEGRATED LOGISTICS SUPPORT PLANNING

Figure 3

the deployment phase is reached, a system oriented logistics support should have been obtained and functioning as an element of the total system that meets the capability requirements of the operational mission.

As stated above, the Logistics Support Plan is the vehicle by which the logistics support is implemented. Elements of the Integrated Logistics Support function were also referred to. No one element can be developed without consideration for the others; however, since this study focuses on manpower planning for support requirements, only the element of personnel and training will be examined.

The personnel and training element of the logistics plan is an integral part of the personnel subsystem program. It defines the requirements for operations and maintenance personnel and training devices to support the system. The planner uses the personnel and training element to identify maintenance and training requirements, describe personnel and training aspects of logistics support programs, to pinpoint new critical skills, to assess availability of trained personnel, and to summarize total manpower resources for ten years.

Management of this element requires that a well defined series of schedules be established. The schedule includes derivation of new training programs, assignment of students, transfer of graduates, and manning of new units. The personnel referred to (students and graduates) are the active duty Air Force personnel that will man operational units and who are responsible for maintaining the aircraft. This includes engine mechanics, avionics repairmen, crew chiefs, etc. This element is extremely sensitive to schedule fluctuations established within other elements of the logistics support plan. This sensitivity is the result of the perishable nature of trained personnel (i.e., they will be deployed elsewhere if not employed at the scheduled time).

The development of this element begins during the conceptual phase of the acquisition process when preliminary estimates of maintenance skill requirements and personnel and training concepts are prepared. During the validation phase, preparation of the personnel and training program evaluation criteria is accomplished, and the personnel and training plan are coordinated by the applicable commands.

The determination of personnel availability, a continuous function, is initiated in the full scale

development phase. This requires a review of personnel requirements compared to availability of personnel skills and quantities. Operations and maintenance personnel training is initiated for military personnel during this phase. Towards the end of full scale development, requisite skill levels are verified through system demonstrations; performance standards are corrected and updated, appropriateness of skill level to task, time required to perform tasks, adequacy of support equipment, and adequacy of other support elements.

In the production phase, the availability of trained personnel for operations and maintenance is verified (availability of trained personnel in required quantities and skills for operating units is confirmed). The personnel and training plan is also updated to assure adequacy of personnel through service tests and demonstrations and update plan.

A careful study might lead one to conclude that logistics support personnel have been excluded. The fact is the term "logistics support personnel" does not specifically exist in the literature. The term "maintenance personnel" may be said to include depot maintenance. The use of the term "operations and maintenance personnel"

implies operations personnel are system operators and maintenance personnel are the base level military maintenance.

The personnel who are trained, transferred, and graduated from technical training are the active duty military personnel performing maintenance functions at the base level. They are not the logistics personnel performing maintenance tasks at the Air Logistics Centers. The absence of logistics support is not surprising, since the majority of support personnel required to support a system that is deployed are at the base level of maintenance.

It appears at this point in the analysis, that personnel required to provide support under the Directorate of Materiel Management are not included in the planning.

The Current Manpower Allocation Process

In the study of any system or procedure, the most difficult task facing the researcher is one of fully understanding the process under study. In this study, the task has proven to be even more difficult since it became somewhat obvious that a method to forecast manpower requirements for the Air Force Logistics Command resulting from a system acquisition did not exist. This statement

is not completely true. What is probably more correct, is to say that a pure model for forecasting manpower requirements does not exist. As previously stated, the planning process inherently assumes that the number of manpower authorizations allocated to the Air Logistics Center, which is receiving the new work load prior to program management responsibility transfer, is sufficient to maintain the system <u>after</u> transfer. This does not mean that the manpower requirements remain static over the life of the system. In fact, as flying hour programs are increased and more information is known about a system, manpower requirements are continually reforecast for the next four to five years.

On the other hand, manpower requirements are established by the Air Logistics Centers in advance of management transfer. Regardless of whether the additional work load is the result of a system acquisition or the transfer of work load from one center to another, the procedures are the same. It is this process which will be analyzed in this section.

In studying manpower requirements, it is necessary to look at the methods used to establish those requirements.

Manpower requirements are supposed to be established according to work load standards. For example: in the item management arena, a requirement is established for a production management specialist based on a standard of one specialist for 120 line items assigned for management. These standards are set as a result of a mutual study effort of the Air Force Logistics Center, the assigned Management Engineering Team (a suborganization of Air Force Logistics Command Headquarters), and the Headquarters Manpower Organization. However, not all positions have standards established. In this case, requirements are zero based. At best, the requirements are established on past experience (where it exists) and subjective reasoning between the parties of concern.

The establishment of manpower requirements for the Acquisition Divisions at the Air Logistics Centers is a case in point. At present, no standards have been established. This is notwithstanding the fact that the divisions have been in operation at the Air Logistics Centers for three years. Presently, there is a concerted effort underway to establish standards for these divisions. The time frame for completing this effort is unknown. The difficulty that arises in developing these standards is the unknown that is generated as a result of systems

acquisition. As previously stated, each system is unique. For example, the performance of the contractor selected by the acquisition agency may generate the need for an estimated standard. If the contractor performs well and does the job the right way the first time, then a standard requiring one person to monitor a portion of the contracted effort can be established. On the other hand, if the contractor does not perform well, it may be decided that additional management manpower is needed. At best, it can be assumed that the contractor will do well and set the standards accordingly.

It should come as no surprise that some standards that are in use are of questionable validity. (E.g., at the Sacramento Air Logistics Center, the Director of Materiel Management has questioned some of the standards used in his directorate). The problem can be shown by looking at the requirements of the divisions and the number of allocations assigned against the requirements. Some divisions are manned at a level of 160 percent while some are manned at 59 percent. Next, we move from manpower standards to the allocation process.

A manpower allocation is the number of personnel that can be employed to fill recognized requirements. The methods used in determining the allocations are somewhat

complex and are best described by an example. When reviewing the example presented, the reader should be aware of three factors: first, is the concept of equal share of allocations among all Air Force Logistics Command units. This concept is intended to insure that each unit will get its fair share of allocations given their stated requirements. Second, the units are functionally oriented and not system oriented. This means that manpower allocations at the units are divided among functional areas such as engineering, system management, item management, distribution, supply, maintenance, etc. This is in contrast to allocations being assigned to specific weapon systems (i.e., F-111 or A-10 aircraft). The functional base is used in spite of the fact that requests for additional allocations are based on new work loads generated by systems. Third, the Air Force Logistics Command has 22 operating organizations that share the allocations. The example will only consider five of these organizations, however, the method described applies across all units.

Example: Within the Air Force Logistics Command structure, there are five Air Logistics Centers. Assume that each center has validated and recognized requirements as follows:

San Antonio Air Logistics Center	4000
Sacramento Air Logistics Center	6000
Warner Robins Air Logistics Center	3500
Oklahoma City Air Logistics Center	4200
Ogden Air Logistics Center	2700
Total	20400

It is assumed that the 20,400 requirements are recognized by Headquarters United States Air Force and the Air Force Logistics Command. Suppose that Headquarters United States Air Force, allocating insufficient manpower, provides only 17,500 manpower allocations to the Air Force Logistics Command to cover the 20,400 requirement. When the 17,500 allocations are received by the command, a leveling factor is calculated by taking the percentage of allocations to requirements. Thus, the leveling factor for this example is:

$$\text{Leveling Factor} = \frac{17,500}{20,400} = .8578$$

To maintain the concept of fair share, that leveling factor is applied to all five Air Logistics Center requirements. Thus, the 17,500 allocations will be distributed as follows:

San Antonio Air Logistics Center	4000(.8578) = 3431
Sacramento Air Logistics Center	6000(.8578) = 5147
Warner Robins Air Logistics Center	3500(.8578) = 3002

Oklahoma City Air Logistics Center 4200(.8578) = 3603

Ogden Air Logistics Center   2700(.8578) = 2317

Thus, the center requirements are established and the allocation assigned. Next, we examine what happens when a new work load resulting from a system acquisition is assigned to one of the centers.

Suppose Warner Robins Air Logistics Center Acquisition Division has established a requirement for 120 additional personnel to support an additional system "X" that will be transferred to the center in two years. It will be further assumed that Headquarters Air Force has recognized that the Air Force Logistics Command will require an additional 120 allocations based on the transfer of management responsibility of system "X" from the acquisition agency to the Air Force Logistics Command. Therefore, 120 additional allocations are provided to the command. (It is at this point in the process that allocations are distributed functionally rather than by systems). As a result of the authorization, the established requirements for Warner Robins Air Logistics Center will have increased from 3500 to 3620 while the requirements for the other centers remain the same. However, a new leveling factor is now calculated:

$$\text{Leveling Factor} = \frac{17,500 + 120}{20,400 + 120} = .8586$$

Applying this new factor to the centers' requirements provides a new set of allocations:

    San Antonio Air Logistics Center   4000(.8586) = 3434

    Sacramento Air Logistics Center   6000(.8586) = 5152

    Warner Robins Air Logistics Center 3620(.8586) = 3108

    Oklahoma City Air Logistics Center 4200(.8586) = 3607

    Ogden Air Logistics Center   2700(.8586) = 2319

In this example, Warner Robins Air Logistics Center received only 106 additional allocations against the established work load requirement of 120. Each of the other centers received two to five "windfall allocations."

However, even the 106 may not reach the original target organization. Once received at the center level, the total 3108 allocations are distributed as required. This means that the center commander, for example, assigns 12 of the 106 allocations to maintenance due to higher priority work requirements. The remaining 94 allocations are then assigned to the Director of Materiel Management who has the same prerogative as the center commander concerning the use of the additional allocations. He assigns six of the 94 allocations to the System Management Division and the remaining 88 to the Acquisition Division. Figure 4

traces the procedures from the originating agency through the necessary levels of management back to the originating unit.

As shown by the example, the end result of the method employed is that it is conceivable that the recognized requirement for support of a system obtained by a center through transfer of management responsibility could receive zero allocations for the new work load.

Program Management Responsibility Transfer

As stated throughout this chapter, the Air Force Logistics Command receives new work loads as a result of the acquisition process, and the mechanism used is the transfer of program management responsibility. The time frame for planning and the allocation of manpower by the Air Force Logistics Command are based on what work load is being transferred and when the transfer will take place.

The key element in the planning and allocation process is the date the management responsibility is transferred from the acquisition agency to the supporting command. It is the established date that resource planning for the supporting command bases its manpower requirements, depot maintenance facilities, and all other aspects of support.

MANPOWER REQUIREMENTS AND
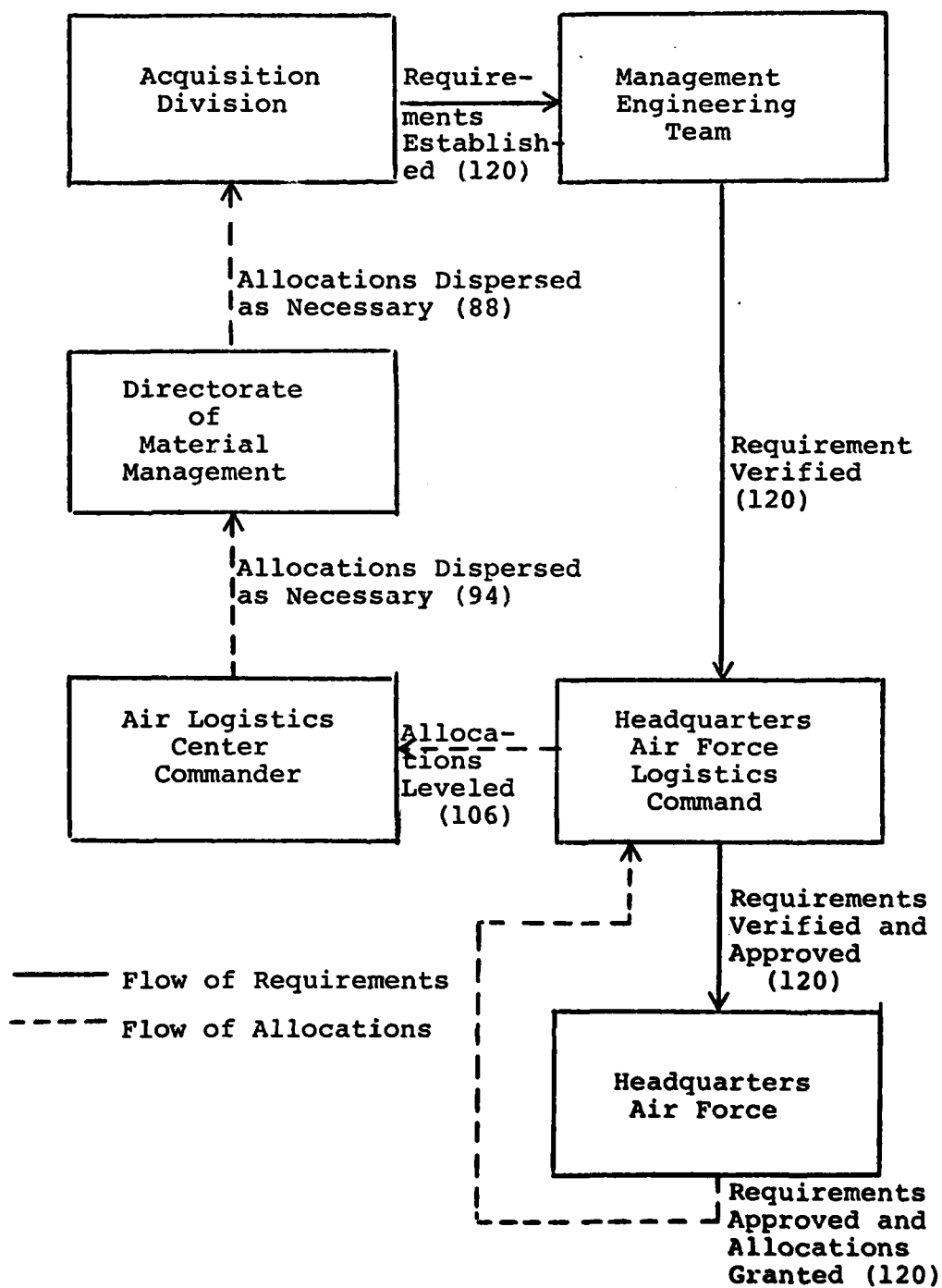
ALLOCATION FLOW EXAMPLE

Figure 4

According to all printed regulations, manuals, and guides, the transfer date is supposed to occur early in the production phase of the acquisition cycle. However, historically this has not been the case. The general rule currently used on the F-15 and F-16 weapon system acquisition is that the transfer will occur six months after issuance of the last production contract. The transfer date for the A-10 aircraft was established on the same premise. The date was scheduled for May 1979 based on the issuance of the last production contract that was to be issued in December 1978. However, Congressional action spread the production effort out in such a manner that an additional production contract will be issued. Thus, the transfer date must be reestablished. The importance of establishing the date and not changing the date should not be underestimated. Each responsible command must budget for all required tasks based on the established transfer date. With the budgeting cycle being two years in length, to change the date can mean that the support command may have all the funds necessary to manage the system when, in fact, the acquisition agency will keep the system for an additional time frame.

One of the main factors which is affected is the development of manpower resources to manage the system.

Manpower requirements are established and projected based on the established transfer date. If the work load is not transferred at the stated time, the manpower resources will invariably be used elsewhere. As an example of this problem, consider a case study performed by the United States Army (Neal, 1977). Special equipment had been developed for deployment to Europe and support personnel required to maintain the equipment had been trained and transferred to Europe. The equipment was subsequently delayed by one year; and by the time it arrived at the operating location, the trained operators and maintenance support personnel had been transferred back to the states since their assignments were completed. The Air Force experience would be comparable.

Perhaps the most difficult question that arises with regard to program management responsibility transfer is: "what work load is transferred?" Basically, the work load that is transferred in the context of weapon system management responsibility is a functional work load. The functional work load may consist of all or some of the following:

a. Program documentation and records.

b. Engineering data.

c. Technical orders.

d. Engineering.

e. Configuration management.

f. Material support.

g. Transportation, packaging, and material handling.

h. Procurement.

i. Budgeting and funding.

j. Security.

k. Environmental assessment and statements.

l. Test and evaluation.

m. Safety.

n. Quality assurance.

To define the work load associated with these functional areas in general terms would be very difficult. First, the work load will be dependent on what was accomplished by the acquisition agency and what needs to be accomplished by the supporting agency after transfer. In most cases, the functions can be considered as ongoing throughout the life of the system, but it is the degree of work that cannot be quantified. Second, a highly reliable system will require less work by the support command than a low reliability system. This will affect engineering who must reengineer portions of the system, the budgeting and funding programs to implement the reengineering, and the procurement function which must purchase the replacement

hardware. Third, residual tasks may be retained by the acquisition command. As an example of a residual task, consider the transfer of F-111F aircraft. The total system, with the exception of the aircraft engines, was transferred to the Air Force Logistics Command. The acquisition agency maintained responsibility for the engines for an additional year.

To understand better relationship between functions and work loads, consider the function of technical orders. During the acquisition cycle, technical orders are procured so that system operators will have guidance on how to operate the system, and maintenance personnel will have detailed repair procedures to maintain the system. No technical order remains static even it if started out containing no errors. Various events (such as system changes) will require the update of the technical orders. The responsibility for this update prior to management transfer is assigned to the acquisition agency. After transfer, the responsibility transfers to the support command. The magnitude of the impact is unknown but is dependent on the number of technical orders required to support the system, and whether or not the technical order content was verified by the acquisition agency. For instance, the now nonexistent B-1 bomber

program had developed a requirement for 1200 technical
orders compared to approximately 6000 procured to support
the F-111 weapon system. It is known that the rate of
updates required to maintain the F-111 technical orders
averaged 100 per week at the time of transfer.

Prior to the establishment of the Air Force
Acquisition Logistics Division (a unit of the Air Force
Logistics Command) and the Air Logistics Center Acquisition
Divisions, program management responsibility transferred
directly to the System and Item Management Divisions of
the appropriate Air Logistics Center. The process now in
effect is a variable one. For major system acquisition
(such as new aircraft), the Air Force Acquisition Division
is normally assigned to provide input to and monitor the
acquisition process. If a system is in the production
phase of acquisition, the acquisition agency may transfer
the management responsibility to the Air Force Acquisition
Division who, in turn, will transfer the system to the Air
Logistics Center Acquisition Division at some later point
in time. However, it is conceivable that the Air Force
Acquisition Logistics Division could transfer its work
load to the Air Logistics Center Acquisition Division or
the centers' system/item management divisions prior to
the work load transfer from the acquisition agency. If the
latter path is followed, then the acquisition agency will

transfer the work load directly to the Air Logistics Center
System/Item Management Division. This assumes, however,
that the centers' Acquisition Division had previously
transferred their work load to System/Item Management
Divisions. Figure 5 shows the possible paths the transfer
function can take.

The selection of which path is followed is normally
based on the work load of the agencies involved and the
manpower available to support new systems acquisition. For
instance, if the acquisition agency begins an acquisition
of a new major weapon system, then the Air Force Acquisition
Logistics Division will most likely transfer a system to
an Air Logistics Center so that manpower will be available
for the new system in acquisition. This process has a
domino effect since the action is most likely repeated at
the Air Logistics Center level.

FLOW PROCESS POSSIBILITIES

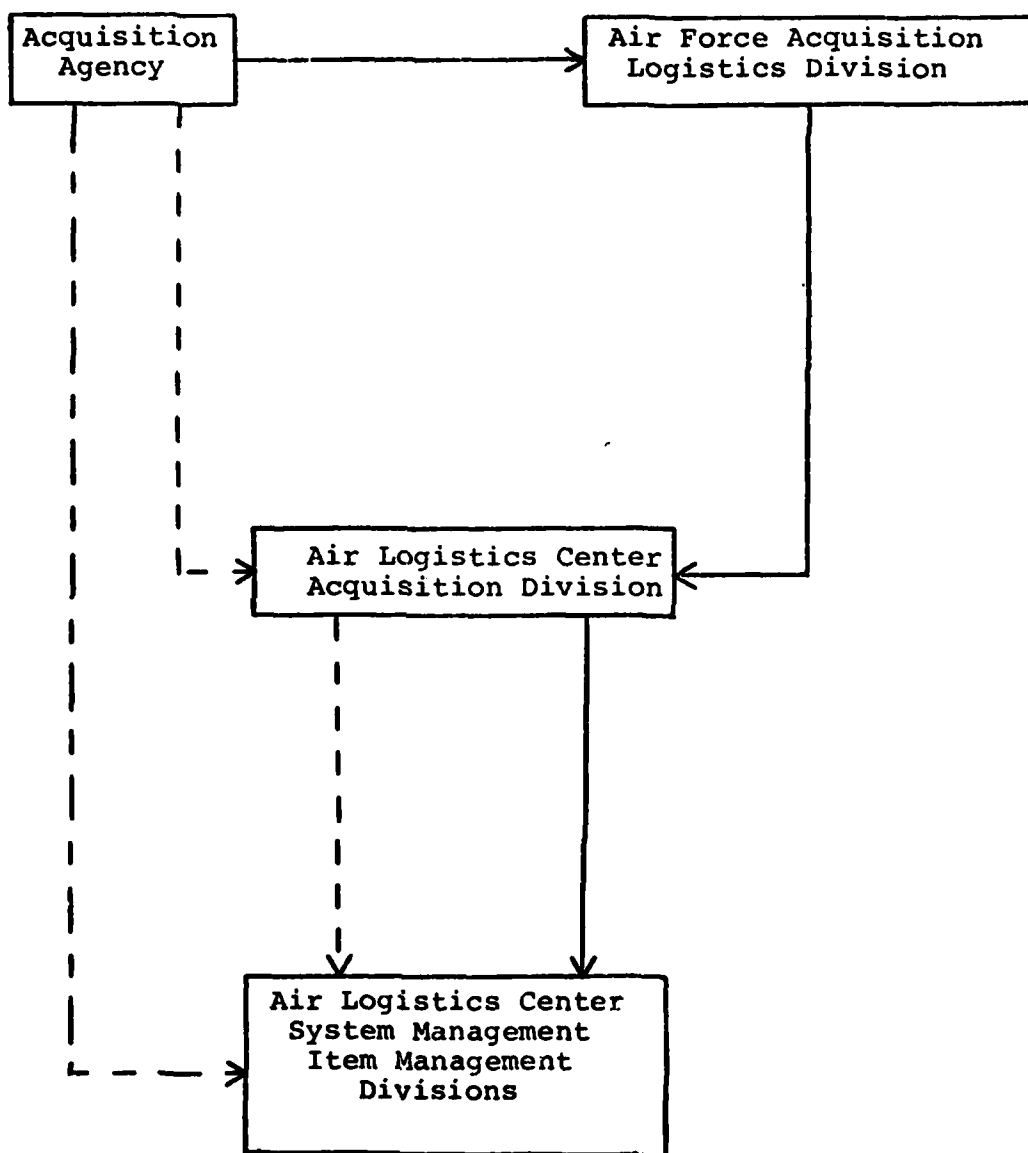## FOR WORK LOAD TRANSFER

Figure 5

Chapter III

ANALYSIS OF MANPOWER PLANNING AND ALLOCATIONS FOR

THE A-10 WEAPON SYSTEM ACQUISITION

This chapter examines the weapon system acquisition
of the A-10 aircraft and its impact on Air Force Logistics
Command manpower. The A-10 acquisition was chosen since
the transfer of management responsibility from the
acquisition agency to the support agency was scheduled
to occur 31 May 1979. In this case study, only the man-
power requirement development for logistics support will
be considered. The reader is cautioned to keep in mind
that although most systems acquisitions are similar in
nature, the uniqueness of each system sets apart various
management techniques employed by the program managers.
Therefore, the finding in this case study may not be com-
pletely generalized to all weapon systems acquisitions.

The primary areas to be considered in this case study
are: (1) the A-10 acquisition cycle, (2) the Air Force
Logistics Command manpower planning and allocations during
the acquisition cycle, (3) the program management responsi-
bility transfer manpower requirements, and (4) the A-10
integrated logistics support plan.

Since certain data were not available in existing records, personal interviews had to be conducted. The data obtained are the results of personal recall of the interviewees. These data will be noted by an asterisk (*). Other data reported were obtained from the files of the A-10 System Program Office, the Air Force Logistics Command Manpower and Organization Directorate, and Sacramento Air Logistics Center.

The A-10 Acquisition Cycle

In the early to mid 1960s*, the United States Air Force developed a mission need for a specialized close air support aircraft to replace the aging A-10 aircraft as the primary weapon system for close air support mission (close air support is defined as aircraft support for ground troops in a combat zone). In approximately 1968*, requests for proposals were forwarded to defense contractors for the development of an aircraft to meet the close air support role. Six contractual proposals received in August 1970 resulted in selection of Northrop Aircraft Company and Fairchild Republic to develop prototype aircraft for competitive flyoff. On 1 March 1973, as a result of the flyoff, a contract was awarded to Fairchild Republic Company to produce ten aircraft. In

the acquisition process, this action initiated the full
scale development phase.

During the fiscal year 1975 (July 1974 through June
1975) budget cycle, the Congress deleted funds for four of
the ten aircraft. In addition, the Senate Armed Services
Committee recommended that a flyoff between the A-10 and
the A-7D aircraft (already in the Air Force inventory)
be conducted to assess the capability of both aircraft to
perform the close air support mission. These actions
resulted in a stop work order to Fairchild Republic
Company, a realignment of the production/delivery schedules
for the first six aircraft, and renegotiations of the
existing contract. The flyoff was conducted and the A-10
was declared the winner over the A-7D by both the Air Force
and the Department of Defense Weapon System Evaluation
Groups. On 9 July 1974, the Defense Systems Acquisition
Review Council met to review the A-10 program. The council
is an office of the Secretary of Defense advisory body con-
sisting of the Director of Defense Research and Engineering,
and Assistant Secretaries of Defense for Program Analysis
and Evaluation, Installations and Logistics, Comptroller,
and, for their particular programs, Intelligences and
Communications. The council noted that excellent progress
had been made on the prototype and development programs of

the aircraft. As a result of that meeting, the Deputy
Secretary of Defense approved the initial production of 52
aircraft. Subsequent Congressional action on the fiscal
year 1975 Department of Defense Appropriations Bill reduced
the A-10 aircraft procurement to 30 aircraft. Full funding
was authorized in July 1975 for 30 aircraft. Thus, the
production cycle began in fiscal year 1975. An additional
Defense System Acquisition Review Council was completed in
February 1976. As a result of the council's review,
approval was granted by the Secretary of Defense for pro-
duction go ahead for 733 A-10 aircraft. The production
was scheduled to be completed in January 1983. The deploy-
ment phase of the acquisition cycle began between April
and June 1976 with the delivery of the first A-10 aircraft
to an operational unit.

In analyzing the A-10 acquisition cycle, note that
several Congressional actions were mentioned. These
instances have been cited to show that a program schedule
is subjected to non-Department of Defense influences.
These influences may or may not impact the integrated
logistics support planning function.

Air Force Logistics Command Manpower Planning and Allocation
During Acquisition

First, the reader is reminded that this discussion of
the Air Force Logistics Command manpower during the A-10
acquisition manpower planning and allocations does not
address depot maintenance personnel. Second, remember
that all Air Logistics Centers are impacted by the acquisi-
tion of a system. For instance, with the A-10, the system
management function for the airframe is assigned to the
Sacramento Air Logistics Center; the aircraft engines to
San Antonio Air Logistics Center; and the gun to Warner
Robins Air Logistics Center. However, in most cases, it
is the system Air Logistics Center which receives the
greatest work load as a result of a new system acquisition
program.

In March 1970, the Air Force received authorization
for the acquisition of the A-10. As a result of this
action, a System Program Office (the responsible acquisi-
tion agency) was formed. The Air Force Logistics Command
(the support agency), the Tactical Air Command (the
designed system operator), and the Air Training Command
(operations and training responsible agency) assigned
personnel to the System Program Office. The Program
Office organization for the A-10 is essentially the same
as that shown in Figure 1. Five to six* Air Force
Logistics Command personnel were involved at this point
in time. However, the equivalent of five* logistics

command personnel was involved in the acquisition process between 1966-1970*. During the period 1970-1974*, the Air Force Logistics Command manpower allocations were in the range of 10-20*. This included manpower allocations to the Program Office and the Sacramento Air Logistics Center. It should be noted, there was no manpower planning for the Directorate of Materiel Management for the A-10 support during the period 1966-1974. This was not an intentional lack of planning but resulted from the way in which the procedure was conducted. During the early portions of the acquisition cycle, schedules are not finalized and those that are, are subject to changes. Therefore, it was impractical if not impossible to project requirements during these early phases. The balance of this section will address only the Sacramento Air Logistics Center manpower planning and allocations for the A-10 aircraft.

In November 1975*, the center developed the first A-10 manpower support requirement package. This planning package was submitted to the Air Force Logistics Command Manpower and Organization Directorate in January 1976. The package was developed and submitted in anticipation of the approval for the A-10 aircraft. At this time, the center was authorized 46 personnel to support the acquisition. The package submitted showed a requirement for a

manpower buildup through the fourth quarter of fiscal year 1976 (May-June 1977). The projected requirements and approved allocations presented in the package are shown in Table 1.

MANPOWER REQUIREMENTS AND ALLOCATIONS NOVEMBER 1975		
TIME FRAME	PROJECTED REQUIREMENTS	AUTHORIZED ALLOCATIONS
October-December 1975	53	46
January-March 1975	68	46
April-June 1975	84	46
April-June 1976	86	46

Table 1

At the beginning of fiscal year 1975, a change in planning procedures was initiated by the Air Force. The new procedures required that manpower requirements be submitted 24 months in advance of the time for which the requirements are needed. For example, if an organization develops a requirement for additional manpower in fiscal year 1981 (October 1980-September 1981), the requirement must be submitted prior to October 1978. (NOTE: The fiscal year periods were changed by Congress in 1976 from

July through June to October through September effective
1 October 1976). As a result of the planning procedure
changes, the manpower package submitted in November 1975
was disapproved since the requirements could not be
entered into the planning cycle for which the requirements
were needed. Ultimately, the package was submitted two
years late.

However, during the period November 1974* to June
1976*, the requirements were adjusted to 61 and the allo-
cations were set at 61.

The second manpower package for the Sacramento Air
Logistics Center's Acquisition Division in support of the
A-10 aircraft was submitted to the Headquarters Air Force
Logistics Command in December 1976. Recall that the
requirements and allocations prior to December 1976 in
support of the A-10 aircraft were 61. Table 2 shows the
additional manpower requirement projected and reported in
this package.

Since requirements are to be submitted two years in
advance, it can be seen that the package was not submitted
in sufficient time to cover the requirements through
December 1978. However, the package was not rejected in
total. The Air Force Logistics Command Directorate of

Manpower and Organization did provide an additional 57 allocations to the center for support of the A-10 aircraft. When those allocations were received by the center, only 12 were provided to the Acquisition Division and the other 45 were allocated to other programs considered to be of a higher priority. These programs could not be identified. Subsequently, allocations for the Acquisition Division in support of the A-10 have grown to and fluctuated around 88 to the present time.

SACRAMENTO AIR LOGISTICS CENTER ACQUISITION DIVISION		
A-10 MANPOWER REQUIREMENTS		
DECEMBER 1976		
TIME FRAME	ADDITIONAL PROJECTED REQUIREMENTS	TOTAL REQUIREMENTS
October-December 1977	39	100
January-March 1978	40	101
May-June 1978	57	118
July-September 1978	57	118
July-September 1979	66	127
July-September 1980	68	129
July-September 1981	69	130

Table 2

In March 1978, the third manpower planning package was submitted to the Headquarters Air Force Logistics Command. The package contained some discrepancies and was returned to the center to be reworked. The final package with corrections was then submitted 17 October 1978. The additional requirements plus the total requirements described in this package are shown in Table 3.

SACRAMENTO AIR LOGISTICS CENTER ACQUISITION DIVISION

A-10 MANPOWER REQUIREMENTS AND ALLOCATIONS

17 OCTOBER 1978

TIME FRAME	ADDITIONAL REQUIREMENTS	CURRENT ALLOCATIONS	TOTAL REQUIREMENTS
By September 1979	90	88	178
By September 1980	86	92	178
By September 1981	86	92	178
By September 1982	86	92	178
By September 1983	86	92	178

Table 3

Although the package was very extensive and detailed, it was rejected based on a headquarters assumption that the requirements were inflated. Therefore, the center's requirements for support of the A-10 aircraft were

recognized at 130 and leveled to 104 allocations using the leveling procedure explained in Chapter 2. Although the A-10 program at the center has 104 allocations, the Directorate of Materiel Management has authorized only 85 personnel to the Acquisition Division to support the aircraft. The other 19 allocations are being used for other programs deemed to be of higher priority. The identification of these other programs cannot be identified since the allocation process at the center level is functionally oriented and not system oriented.

The major result of the deficient authorization is that the third package has been submitted by Sacramento Air Logistics Center requesting additional manpower authorizations necessary to assume management responsibility of the A-10 system at the time of transfer. This request was based on an assumed transfer date of 30 May 1979. It should be noted, however, that the transfer date is presently under consideration for change. The new date has not been established but it is recommended that the transfer should occur during the period October 1979-January 1981.

The Program Management Responsibility Transfer Requirements

The changing of the transfer date, while affecting the manpower allocations time table, does not significantly

reduce the new work load that will be transferred to the
Sacramento Air Logistics Center. Referring to Table 3,
the additional requirements include 86; 40 are for antici-
pated current work load increases and 46 are for support
of the new work load. Headquarters Air Force Logistics
Command has questioned the nature of this increased work
load. The new work load was identified in the 17 October
1978 manpower package. A partial listing of the functional
responsibilities that the center will assume on the trans-
fer date is shown in Figure 6.

The failure to recognize this new work load will
result in the crisis management situation alluded to in
Chapter 2. The basis for the rejections of these require-
ments is that the work load is not quantifiable and is
based solely on subjective reasoning. This leads to the
question of integrated logistics support planning. Was
the planning adequate to preclude this lack of recognition?
To evaluate this question, a discussion of the A-10
integrated logistics support plan follows.

The A-10 Integrated Logistics Support Plan

As of May 1979, there was no integrated logistics
support plan for the A-10 weapon system. In the 1975-1976*
time frame, the program management plan for the A-10 was

FUNCTIONAL RESPONSIBILITIES ASSUMED BY

SACRAMENTO AIR LOGISTICS CENTER IN

SUPPORT OF THE A-10 AIRCRAFT

System Engineering

Training and Training Equipment Management

Engineering Changes

Aircraft Acceptance

Waiver and Deviations

Quality Assurance

Specification Management

Spares Contracting

Accident and Incidents

System Safety

Modification Management

Site Activation

Technical Orders Management

Figure 6

terminated by the program director. This was done in con-
junction with the development of the A-10 management infor-
mation system which replaced the management plan. Included
in the management information system was some logistics
support information but not in the detail of a logistics
support plan, since the planning had been completed and
the system was in production. The last updated plan for
the A-10 was issued in September 1975. It was this docu-
ment that was reviewed for this case study. Once again,
only the element of personnel and training will be examined.

The personnel and training element of the A-10 support
plan was devoted to the training of the logistics personnel.
(NOTE: This is contrary to the discussion of the personnel
and training element in Chapter 2 which seemingly omitted
consideration of logistics support personnel). Pertinent
paragraphs of the personnel and training element of the
A-10 support plan are quoted and discussed as deemed
necessary.

"...Air Force Logistics Command personnel will
require training in five specific areas. These are:
pilot training, engineering training, depot overhaul
training, intermediate level training, and management/
engineering training." The training for the pilots,
engineering, and depot overhaul is concerned with the

maintenance aspect of the logistics support. The training
for engineering, intermediate level, and management/engi-
neering is concerned with the support role of logistics
personnel. For instance, intermediate level training,
although an operational function, allows for the Air
Logistics Center equipment specialist and technicians to
become familiar with the equipment they will manage at
after program management transfer.

"A manpower validation model will be used in place
of the qualitative and quantitative personnel requirements
information (QQPRI). This model will provide information
similar to that normally contained in the QQPRI. (NOTE:
The qualitative and quantitative personnel requirements
information is the methodology used to relate maintenance
task to required skills needed to perform that task. It
uses information from other studies such as reliability,
maintainability, etc. Based on this information, predic-
tions of the number of personnel in each skill required
to maintain the system is made. However, this is limited
to field level personnel). The manpower validation model
used in lieu of the qualitative and quantitative personnel
requirements information for the A-10 was a model developed
by the Air Force Human Resources Laboratory. The report
(Tetmeyer, 1974) describing this model states, "The

methodology and models described in this volume have been successfully applied on the A-10 program...." The model does not include logistics support personnel but does indicate that "work is underway in conjunction with Air Force Logistics Command to incorporate this methodology into a system for total logistics trade offs and life cycle costing."

Summary and Conclusions

There are several conclusions that can be drawn from this case study, however, only those consluions that have a direct impact on the manpower planning and allocation process will be addressed.

The Sacramento Air Logistics Center, in November 1975, December 1976, and October 1978, submitted a manpower package requesting additional personnel to support the A-10 weapon system to Headquarters Air Force Logistics Command. The three manpower packages were considered "late" since manpower requirements for the first two years from the date of the package were included and a requirement existed for a manpower package to be submitted 24 months in advance of the time the manpower requirement is needed. It can be concluded that the manpower planners at the Sacramento Air Logistics Center are not aware of or

disregard the planning cycle time frame. It is possible
for the center to acquire a work load which will not allow
for the 24 month advance planning; but in this case, suf-
ficient time was available.

The third manpower package, submitted by Sacramento
Air Logistics Center, was rejected by the headquarters
based on an assumption that the requirements were inflated.
Recalling from Chapter 2 that manpower requirements are
established and approved by the operating units'
Management Engineering Teams, the planning for manpower
should be considered as a wasted effort.

Manpower requirements submitted by Sacramento Air
Logistics Center were for support of the A-10 weapon sys-
tem. Although the current recognized requirement is 130,
tne requirements have been leveled to 104 through the
leveling technique explained in Chapter 2. Of the 104
allocations provided to the center, 85 were allocated to
the requesting division and 19 allocations to other
divisions deemed to have a higher priority work load.
Therefore, it is concluded that other operating units
have reaped a windfall of allocations based on the require-
ments of one division at Sacramento Air Logistics Center.
It can be further concluded that the basis for manpower

allocations is inconsistent with the basis for determining manpower requirements.

New work loads that result from system acquisition are not quantifiable and are based solely on subjective reasoning; therefore, this work load is not recognized by headquarters. The fact that the incoming work load cannot at some degree be measured objectively indicates a lack of coordination between the System Program Office, the Acquisition Logistics Division, the Sacramento Air Logistics Center, and the Headquarters Air Force Logistics Command.

While the A-10 Integrated Logistics Support Plan considered training requirements for logistics support personnel, manpower requirements were not addressed. Throughout the above discussion on manpower planning, it is shown that the manpower planning for support of the A-10 was done in isolation to the System Program Office which has the responsibility for this planning. Thus, it is concluded that manpower requirements for the Directorate of Materiel Management at Sacramento Air Logistics Center in support of the A-10 weapon system cannot have a sound basis in relation to the work load the center will receive.

Chapter IV

MANPOWER ALLOCATION MODEL

Manpower planning throughout the Air Force Logistics
Command complex, with regards to weapon systems acquisi-
tion, is basically oriented to the manpower requirements
necessary for the command to manage the system after
acquisition and transfer of program management responsi-
bility. However, the allocation of manpower, especially
at the Air Logistics Centers, is functionally oriented.
As was found in the A-10 aircraft case study, the addi-
tional requirements needed to support the system after
transfer were not recognized. This means that the command
did not seek additional allocations from Headquarters Air
Force. The excuse offered by the command is essentially
that a method is not available to relate manpower require-
ments to systems. Further, there is no control mechanism
to advise Headquarters Air Force when a work load has
decreased.

The purpose of this chapter is to explore a method
that can relate manpower requirements to systems and
manpower allocations to those requirements.

Model Development

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One factor that can be used to relate a major aircraft system to other systems is the number of flying hours assigned to each system by Headquarters Air Force. It is also known that aircraft support requirements are a function of flying hours. The flying hour programs are published at frequent intervals and are subject to change. As a result, flying hour programs can be said to be variable. This variability can be caused by a decrease in available aviation fuel, or flying hour programs can vary based on the phasing in or out of new and older systems.

Flying hour programs are, at best, estimates. Factors such as fuel availability, international crisis, aircraft maintainability, and aircraft reliability will cause these estimates to vary. For example, the United States Government may offer airlift support to a foreign government to fly in medical, food, and other supplies to a country struck by an earthquake. Since earthquakes are not forecasted, planning for flying hour programs will not include these types of emergencies. On the other hand, an oil boycott by the world oil ministers can cause a cut in flying hour programs due to a shortage of aviation fuel. Thus, there is uncertainty in the number of flying hours a system may accumulate during a period of time.

Since there is a set of three possible flying hour
estimates (minimum, most probable and a maximum), the
problem of reducing these estimates to a single average
estimate (u) can be solved by using the Beta distribution.
This is similar to the PERT methodology which takes
uncertainty into account by assuming that time estimates
were probability distributions and the schedules for all
of the activities reflected the uncertainty of the
activity times (Buffa and Taubert, 1972).

Thus, to incorporate the variability of flying hours
over time for a given system, it will be assumed that the
expected flying hours for any given system can be repre-
sented by the Beta distribution of the form;

$$u = \frac{a + 4m + b}{6}$$

where: m is the most probable flying hours

a is the minimum number of flying hours

b is the maximum number of flying hours

With this equation, the expected flying hours for each
system at each Air Logistics Center can be calculated.
Since flying hours are a common attribute of all aircraft
systems, this attribute will be used as a basis for
developing manpower requirements and allocations.

The next step in the process requires that the total expected flying hours for each center and the total flying hours for all programs be determined. With these results, a computed weighting factor can be obtained by taking the ratio of the sum for each center to the total for all centers. Consider the following example:

Example: Assume there are three Air Logistics Centers and each center manages two aircraft systems. Denote the centers by subscripts A, B, and C, with numerical subscripts 1 and 2 to denote the aircraft systems. Flying hours will be assumed. Then:

$$u_{A1} = \frac{900 + 4(1000) + 1200}{6} = 1016 \text{ hours}$$

$$u_{A2} = \frac{1000 + 4(1100) + 1250}{6} = 1108 \text{ hours}$$

$$u_{B1} = \frac{800 + 4(950) + 1050}{6} = 941 \text{ hours}$$

$$u_{B2} = \frac{1200 + 4(1400) + 1500}{6} = 1383 \text{ hours}$$

$$u_{C1} = \frac{1100 + 4(1250) + 1350}{6} = 1241 \text{ hours}$$

$$u_{C2} = \frac{700 + 4(850) + 900}{6} = 833 \text{ hours}$$

The total expected hours for all systems at all centers are 6522. Weighting factors for each center, then, are the ratio of total center hours to all system hours:

$$C_A = \frac{1016 + 1108}{6522} = .326$$

$$C_B = \frac{941 + 1383}{6522} = .356$$

$$C_C = \frac{1241 + 833}{6522} = .318$$

The calculated weighting factors will be used later.

The next step in this procedure requires the determination of a manpower factor for each program at the centers. This factor relates the number of personnel required to support a system to the number of flying hours for the system. Since some systems are more complex than others, the factor will vary. A method for determining the factors will be discussed in the next chapter. For this model, the factors, expressed in support persons for flying hours, will be assumed to be:

$A_1 = .8$ $\qquad\qquad$ $B_2 = .95$

$A_2 = 1.0$ $\qquad\qquad$ $C_1 = .85$

$B_1 = 1.1$ $\qquad\qquad$ $C_2 = .90$

Applying these factors to the expected number of flying hours for each program yields the manpower requirements required to support the individual systems. Therefore, the estimated manpower requirements (MR) will be:

$$MR_{A1} = .8 \ X \ 1016 = 813$$

$$MR_{A2} = 1.0 \ X \ 1108 = 1108$$

$$MR_{B1} = 1.1 \ X \ 941 = 1035$$

$$MR_{B2} = .95 \ X \ 1383 = 1314$$

$$MR_{C1} = .85 \ X \ 1241 = 1055$$

$$MR_{C2} = .90 \ X \ 833 = 750$$

TOTAL SUPPORT   = 6075

It is assumed that included in the above factors was an allowance for indirect support. This implies that a minimum number of personnel will be required to directly support the system in order to maintain a wartime capability. Therefore, it will be assumed that as a minimum, each center will need 50 percent of the estimated requirements. Thus, the minimum manpower for each center is:

A = 1921 X .5 =   960

B = 2349 X .5 = 1174

C = 1805 X .5 = 902

Total Minimum
    Requirements   3036

With the manpower allocation to the various commands being controlled by Headquarters Air Force, the expected number of allocations to the Headquarters Air Force Logistics Command will equal 80 percent of the stated requirements. Thus, the total allocation for the centers will be 4860. The difference between total allocation and minimum requirement (4860 - 3036 = 1824) is the unassigned allocations which are available to be distributed on the basis of the objective function.

With the above generated data, an assignment algorithm can be constructed. The objective equation used in the algorithm makes use of the weighting factors calculated above. The use of these factors will insure that the logistics center with the greatest proportional work load will receive the greatest proportion of manpower allocations. The model is of the form of a linear programming algorithm such that:

Maximize $Z = C_A X_A + C_B X_B + C_C X_C$

Subject to: $X_A + X_B + X_C \leq$ Manpower Available-Minimum

Requirements.

$X_A \leq$ Center Requirements-Center Minimum.

$X_B \leq$ Center Requirements-Center Minimum.

$X_C \leq$ Center Requirements-Center Minimum.

$X_A, X_B, X_C \geq 0$

Where: X_A, X_B, X_C represent the additional manpower

allocations to the respective centers.

Therefore, algorithm for this model will be:

Maximize $Z = .326X_A + .356X_B + .318X_C$

Subject to: $X_A + X_B + X_C \leq 1824$

$X_A \leq 961$

$X_B \leq 1175$

$X_C \leq 903$

$X_A, X_B, X_C \geq 0$

To solve the algorithm requires the constraints be converted to the standard form such that:

Maximize $Z = .326X_A = .356X_B + .318X_C$

Subject to:
$$X_A + X_B + X_C + X_D = 1824$$
$$X_A + X_E = 961$$
$$X_B + X_F = 1175$$
$$X_C + X_G = 903$$
$$X_A, X_B, X_C, X_D, X_E, X_F, X_G \geq 0$$

Inspection of the example shows the solution to be by the following rule: Select the center with the highest weighting factor and allocate as many manpower units as possible or needed, whichever is smaller. Move to the next highest weighting factor and repeat the allocation process. Continue the process until all centers have been considered or the number of manpower allocations available is exhausted, whichever comes first.

$X_A = 649$ $X_D = 0$ $X_G = 0$

$X_B = 1175$ $X_E = 0$

$X_C = 0$ $X_F = 0$

Then using this allocation process, the manpower allocations to the three centers will be:

Center A - 1609

Center B - 2349

Center C - 902

In order to compare these results with the current method, it will be assumed that the stated requirements for each center are the same as those calculated above. Then applying the leveling technique the level factor will be:

$$LF = \frac{\text{Allocations Authorized}}{\text{Total Support Requirements}} = \frac{4860}{6075} = .80$$

Applying these factors to the requirements, each center would then receive the following allocations:

Center A - 1536

Center B - 1879

Center C - 1444

These results indicate that Centers A and B, even though they have the largest work load, will receive fewer allocations to perform their task.

Model Advantages/Disadvantages

The primary advantage of the proposed allocation model is that manpower requirements and allocations can be related directly to weapon systems. Thus, as flying hours increase, the Air Force Logistics Command will have a sound basis upon which to request additional manpower allocations from the Headquarters Air Force. The second advantage comes into play during the phasing out of the weapon system. This technique can be applied to allocate manpower during both phasing in and phasing out of work loads. During phasing out, the reduction in estimated work loads will affect the objective equation and the requirements; however, the end results will be the most allocations will be assigned where the need is the greatest.

The major disadvantage of this method is that it may be impossible to establish factors which relate manpower requirements for certain jobs within the Air Force Logistics Command complex to flying hours. For instance, the requirement for the staffing of the command headquarters may not be related to flying hour programs. Therefore, it will become necessary to develop supplementary allocation procedures to cover that type of position.

Conclusions

The model described in this chapter could be used for determining manpower requirements and allocations at the

Air Logistics Centers and other operating units where requirements can be related directly to flying hour programs. By using this method, the command can justify to the Headquarters Air Force the need for additional allocations required to support a new system when program management responsibility transfer occurs. More important, however, is the fact that the allocations which are projected using the model are rationally related to the work load imposed by the weapon systems under consideration.

Chapter V

SUMMARY AND CONCLUSIONS

General Discussion

Manpower planning plays an important role in both the private and public sector. For private sector manpower allocations, the general practice employed is to hire the manpower necessary to produce the product, given projected income and expense related to it. The number of persons that can be employed within the public sector is normally limited by broader budget constraints at the state and local levels and by Congressional constraints with regard to Department of Defense organizations. Here, revenues flow from taxes rather than return from the product or service being delivered.

With new weapon systems entering the Air Force inventory at a faster pace than old systems are leaving, the support personnel often must be generated from existing manpower resources. However, it may be possible for the support agency (in this case, the Air Force Logistics Command) to gain additional manpower allocations if the requirements for the manpower can be related to particular weapon systems. The current practice employed by the

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command is to allocate manpower resources to functional areas such as engineering, maintenance, system management, etc., where as original estimates of manpower requirements are based on projections of system operating levels, which do not include logistics manpower.

This analysis of manpower planning for new work loads resulting from the weapon system acquisition found that the actual process is somewhat vague. Although provisions for such a planning function exist, there appears to be a void when it comes to nonoperational logistics support personnel. The concept of integrated logistics support and the support plan developed from this concept theoretically provide for personnel and training. However, operational and maintenance personnel appear to receive the emphasis of this planning function. Logistics support personnel are apparently overlooked. The A-10 aircraft acquisition was analyzed and reported as the case study in this thesis. That study revealed that manpower planning for support personnel at the Sacramento Air Logistics Center was performed as a separate function in the acquisition process. There was no evidence found that the manpower planning process was related to the system acquisition activity.

The allocation system used by the Air Force Logistics Command is intended to be equitable since it is based on a principle of fair share of allocations to all operating units. However, the analysis conducted herein shows that, at the unit operating level, the allocations are based on functional areas where requirements are based on system needs. Using a system oriented planning and allocation process for logistics support, similar to the one developed in this study, will allow for manpower planning and allocations to be based on a total system program. Using flying hour programs as the common ground applicable to all systems, then verifiable requirements can be maintained.

Limitations and Suggestions for Further Research

The modeling technique presented in Chapter 4 should not be considered as the solution to the total Air Force Logistics Command manpower planning and allocation process. The model has not been tested but simply developed and was based on a single case study. Additional work will be required to fully develop the system complexity factors used to determine manpower requirements. The minimum manpower allocations (50% of requirements) used in the model were subjective and require that a study be conducted to determine the minimum allocations for each operating location. Thus, the underlying concept presented should

be subjected to further study. With the concept as a
starting point, further studies can be initiated to
validate the concept of a system oriented manpower planning
and allocation process.

Studies in the area of work standards should be con-
sidered. Presently all operating units establish their
own standards. It is believed that some of the standards
developed at one operating unit are applicable at others.
Thus, the standards study should be geared to a consoli-
dated effort so that standards across all operating units
can be standardized.

Conclusions

The integrated manpower planning process, as it is now
conducted during weapon system acquisition, systematically
ignores manpower requirements for Air Force Logistics
Command support personnel.

When support manpower requirements are established,
the basis for their determination is _system operating_ con-
siderations. When allocations are finally made, the basis
for the Air Force Logistics Command is _functional_. The
inconsistency in planning bases effectively short changes
the logistics support function. A program of allocation,

which relates all support manpower to system parameters, is severely needed.

Manpower allocations, as they are currently implemented in the Air Force Logistics Command manpower process, systematically short changes the Air Logistics Center receiving the additional work load which accompanies a new weapon system acquisition and distributes the shortfall to other Logistics Centers.

An allocation algorithm, which fixes minimum manpower quotas and which distributes the remainder of the allocations on a weighted basis, will produce "fairer" allocations consistent with established work loads.

Appendix

SOME PERSONAL THOUGHTS ON THE ROLE OF THE
INDUSTRIAL ENGINEER IN THE MANPOWER PLANNING AND
ALLOCATION PROCESS

Historically, manpower planning in the private sector
has been a function of the personnel staffs within a busi-
ness or corporation. In the public sector, the personnel
department also provides the necessary inputs to manage-
ment concerning manpower planning. However, what should
be considered as a vital input to any planning function
is the role that the industrial engineer can play to
enhance this function. The purpose of this Appendix is
to attempt to identify what inputs the industrial engineer
can make in the planning and allocation processes in both
the private and public sector.

The Private Sector

Referring to Armstrong's comments stated in Chapter
2 of this study, "using increased productivity with the
current work force as a means of accepting new work without
additional hiring" lead one to believe that such a pro-
ductivity study can be performed by the industrial engineer.
Work standards can be developed by the industrial engineer
for all phases of the business operation and a determination

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can be made if a change in standard would result in excessive manpower that could be used for additional new work. Further, the industrial engineer can perform plant layout studies so that an optimal placement of new equipment will help determine the optimal number of personnel required to operate the equipment.

The industrial engineer, using predetermined time systems and other techniques can evaluate the new work loads to determine manpower requirements. Other techniques (such as linear programming, assignment algorithms, and the transportation algorithm used by the industrial engineer) can provide vital information to management as to the optimal manpower allocations for work loads.

These types of information can be used by the personnel staffs and other management functions in planning for and the allocations of manpower.

The Public Sector

Increased productivity of the current work force within the public sector is a major concern of government agencies at the local, state, and federal levels. This is due to, as previously stated, a continued decrease in budgets necessary to acquire personnel to maintain an ever increasing work load. In this sector, the role of the

industrial engineer will be discussed in relation to new
work loads generated as a result of weapon systems acquisi-
tions within the United States Air Force.

The industrial engineer's role in weapon system
development cannot be overlooked. The industrial engineer
could provide valuable inputs to the system design process
early in the acquisition process. Most of these inputs
would be human factor engineering information, but these
inputs will have an effect on manpower planning and alloca-
tions at a later time. For instance, the industrial
engineer using his/her human factor's knowledge, can
influence the design of systems or subsystems that will
insure that a man-machine interface is considered in that
design. A subsystem may be designed without the benefit
of the human factors and the end result could be that two
operators would be required to operate the system. On
the other hand, if human factors had been applied, one
operator may be required.

Therefore, the industrial engineer's inputs to the
design of any system will be an influencing factor in man-
power planning and allocations, even though in most
cases this influence is not or cannot be recognized.
However, this is just the first identifiable role the

industrial engineer has in the planning and allocation process within Air Force.

Two Air Force Logistics Command organizations (the Directorate of Manpower and Organization and Management Engineering Teams - a sub unit of this directorate) were alluded to in Chapter 2. It is this directorate that allocates manpower spaces to all command operating units. The staff of this organization consists of several industrial engineers whose responsibilities include determining current manpower requirements and future requirements. The organization reviews all manpower requirements and planning documents submitted by the command operating units and either approves or disapproves the requirements.

The Management Engineering Teams are local detachments assigned to most of the operating units. The Management Engineering Teams are manned mostly by industrial engineers and provide services to the local commanders in terms of manpower planning and validation of requirements. An additional function of the Management Engineering Teams is to establish new and validate existing manpower standards. When it is determined that a new work load is being assigned to an operating unit, it is the Management Engineering Teams' personnel who develop the standards for the new work load and determine what manpower requirements

will be required to meet these standards. Predeter-
mined time systems and other work measurement techniques
are used in developing the standards.

In Chapter 4 of this study, weapon system complexity
factors were used in the development of the model pre-
sented. There are perhaps several ways that the factors
could be developed. However, the key discipline that
would have the necessary training and techniques to
develop these factors is the industrial engineer disci-
pline. Work measurement studies and predetermined time
system techniques would be employed by the industrial
engineer to determine how long it takes and the complexity
of repair to systems and their associated subsystems.
This data, along with system reliability and maintain-
ability information taken from existing maintenance
reports, will enable the industrial engineer to develop
the necessary factors to use in determining manpower
requirements.

It should be emphasized that not all job positions
within the Air Force Logistics Command have had standards
applied. It is the lack of these standards that hamper
the current manpower planning process. It is difficult to
justify manpower requirements when the standards do not
exist. The basic problem is that the growth of manpower

requirements during wartime conditions followed by the
continuous development of new and more complex systems
continues at a pace far greater than the capabilities of
command's industrial engineers to develop standards. A
concerted effort is being made to develop the needed
standards, but the present engineering staff is inadequate.

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